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Development of Interactive Student Worksheets in Mathematics Learning to Increase Problem Solving Ability and Learning Independence of Students of MTsN 2 Labuhanbatu

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Abstract
This study aims to: (1) analyze the validity, practicality and effectiveness of interactive student worksheets (LKPD) developed to improve mathematical problem solving abilities and learning independence; and (2) analyzing the improvement of students' mathematical problem solving abilities and independent learning by developing interactive Student Worksheets. This study uses a 4-D Thiagaradjan development model. In this study, an interactive Student Worksheet was developed. The subjects in this study were students of MTs Negeri 2 Labuhanbatu class VIII based on the consideration that all class VIII of MTs Negeri 2 Labuhanbatu studied sequences and series number patterns. From the results of this development obtained: (1) The validity of the developed learning tools are included in the valid category; (2) The learning tools developed, namely the Interactive LKPD meet the practical criteria in terms of the results of the assessment by teachers and students regarding the ease of use of the developed learning tools; (3) The learning tools developed, namely the Interactive LKPD, have met the effective criteria; and (4) The improvement of students' mathematical problem solving abilities using Interactive LKPD on the material of sequences and series numbers increased significantly from trial I to trial II. As well as increasing the learning independence of students using Interactive LKPD learning tools, the material for the number pattern of sequences and series increased significantly in the second trial.
Keywords: Development of interactive student worksheets, problem solving skills, student learning independence
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INTRODUCTION

Learning mathematics is one way that can be taken to realize the goals of the 2013 curriculum. Because through learning mathematics, it can train and develop students' thinking skills, namely: logical, critical, thorough, curious, unyielding and others. This is in accordance with what Sundayana (2013) stated that mathematics is a provision for students to think logically, analytically, systematically, critically and creatively. This ability is needed by students in problem solving. In addition, the usefulness of mathematics in real life is also undeniable, this is proven by the use of mathematics in all fields of science at various levels of education. Thus, mathematics is indispensable in all areas of life. However, the reality is that the achievement or learning outcomes of mathematics still do not provide maximum results.

Program for International Student Assessment (PISA) 2018, in the category of mathematical ability, Indonesia is ranked 73rd out of 79 PISA participating countries (Hewi, La.2020). Meanwhile, based on Trends in International Mathematics and Science Study (TIMSS) (Rosnawati, 2013) stated that Indonesia's average achievement in TIMSS 2011 was 386, which means it is at a low level and has decreased from the average achievement in TIMSS 2007 which is 397, where The 2011 TIMSS framework is no different from the 2007 TIMSS framework. This proves that the level of intelligence and ability of Indonesian students in solving problems related to mathematics is still low and a decline has been found.

Problem solving is an attempt to find a way out to achieve a goal that cannot be achieved immediately. Seeing the importance of problem solving skills for students, the teacher must really understand the purpose of solving problems in mathematics, in order to be able to help students in learning to solve mathematical problems. Because if students have the ability to solve good mathematical problems automatically aspects of their knowledge and skills have developed well too. As Rahayu & Afriansyah (2015) said, problem solving skills must be possessed by every student. Because problem solving ability is an essential and fundamental ability. Thus we can conclude that problem solving skills are very important in learning mathematics for students at school.

However, the reality on the ground is not as expected. Researchers in class VIII MTs Negeri 2 Labuhanbatu also experienced low mathematical problem solving abilities, this can be seen from the results of observations made by researchers when researchers. When viewed from the results of the researcher's observations, students also have not concluded the results obtained, which means that students have not been able to review the results and processes. There are several students' answers that are not correct in the calculation operation process, causing the answers obtained by students to be incorrect.

Based on Law Number 14 of 2005 concerning teachers and lecturers in article 20 which states that in carrying out professional duties, teachers are obliged to: Plan lessons, carry out quality learning processes, and assess and evaluate learning outcomes. For a teacher, the existence of student activity sheets is an obligation that must be owned by the teacher. For teachers, the presence of student worksheets can help teachers in achieving learning objectives. Student worksheets are included in one of the learning tools. The existence of learning tools is an obligation that must be owned by the teacher. Learning tools are a set of tools that have been prepared for use when teaching. Learning tools are an important part of a learning process.

It is clear that teachers cannot carry out their professional duties if they are not able to plan a quality learning process. To get a quality learning process, teachers must prepare quality learning tools as well. According to Uno (in Rohman & Amri, 2013: 44) Planning is a satisfactory way to make activities run well, accompanied by various anticipatory steps to minimize gaps that occur so that these activities achieve the goals set.

The student worksheet (LKPD) according to Trianto (2011:222) is a student guide used to carry out investigations or problem solving activities. In line with that, Rohman and Amri (2013: 96) state that learning materials that provide student-centered activities are packaged in the form of student worksheets (LKPD). As mentioned above, LKPD is a tool that is very influential in achieving learning objectives. A good LKPD must of course refer to the lesson plans that have been made by the teacher. The questions are not routine questions. Because with the LKPD, the teacher can direct and train students in constructing their knowledge. Of course, the number of activities in the LKPD must be adjusted to the time planned in the RPP. The questions given to the LKPD should be problem solving questions, not just routine questions. LKPD must be designed in such a way that it looks attractive to students, and also the activities in it can involve students to be active in learning.

However, the reality is that the results of observations and interviews with mathematics teachers show that LKPD has not been circulated in MTs N 2 Labuhanbatu and its effectiveness has never been tested. The absence of LKPD means that the RPP prepared by the teacher does not have a worksheet for evaluating student understanding in class. Where the circulating LKPD will include the learning objectives that are linked to the lesson plans prepared by the teacher. The exercises given only contain routine questions which are conclusions or the application of formulas. So the existing exercises do not describe how students construct their knowledge.

In addition, physically, the practice questions are not very interesting and not interactive. Permendikbud No 22 of 2016 the process of implementing learning is held interactively. Dewi in Herawati (2016) Learning using interactive LKPD can create a fun and not boring learning atmosphere, students will not feel pressured, are not afraid to ask questions and create a relaxed learning atmosphere so that it will not make students tense. Interactive LKPD (Herawati, 2016) is one of the alternative media that can be used to support the learning process which consists of material and practice questions which are classified as computer-based media because to run it requires a computer that allows students to increase their knowledge of learning material in an interactive manner. independently with just one button press on the application display. Based on this fact, it is concluded that the student worksheets have not been used in schools, have not referred to problem solving abilities and independent learning and the existing worksheets are not yet interactive.

METHOD

Research Pattern

This study uses a 4-D Thiagaradjan development model. In this study, an interactive Student Worksheet was developed on the material for Sequence and Series Numbers in class VIII of MTs Negeri 2 Labuhanbatu. In addition, researchers also developed research instruments consisting of a problem-solving ability test, a learning independence questionnaire, and student worksheets.

Subject

The subjects in this study were students of MTs Negeri 2 Labuhanbatu class VIII based on the consideration that all class VIII of MTs Negeri 2 Labuhanbatu studied sequences and series number patterns.

Data Analysis

Data Analysis to Calculate Validation, Practicality and Effectiveness

This validation is based on the opinion of experts in the field of mathematics education. Based on the expert opinion, the average value for each aspect is determined, so that the average value of the total aspects is obtained.

The criteria state that student worksheets have a good degree of practicality, if the minimum level of practicality achieved is the practical level. If the level of achievement of practicality is below practical, it is necessary to make revisions based on input (correction) from experts and practitioners. Furthermore, practical activities are carried out again.

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effectiveness activities are carried out again.

Data Analysis of Question Item Validity

Validity relates to the accuracy of the assessment tool against the concept being assessed so that it correctly assesses what should be assessed. So the validity of the items of a test is the measuring accuracy possessed by a question in measuring what should be measured through the item. To determine the calculation of the validity of the item descriptions, the moment product correlation formula is used (Arikunto, 2016), namely:

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X)^2\}\{N\sum Y^2 - (\sum Y)^2\}}}$$

If rcount rtable, it is considered significant, meaning that the questions used are valid.

Data Analysis Improved Problem Solving Kemampuan

To calculate the increase in problem solving abilities after using the development of interactive student worksheets, it is determined by the gain formula, namely:

According to Hake (Yohanis, 2013) the normalized gain is calculated by the following formula:

$$N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

The normalized gain categories are presented in the table below:

Table 1. Normalized gain category

Skor *N-Gain*	N-Gain Criteria
0,00 < *N-Gain* ≤ 0,30	Low
0,30 < *N-Gain* ≤ 0,70	Currently
N-Gain > 0,70	Tall

Adapted from Hake (Yohanis,2013)

Data analysis of students' learning independence

The statements used in the learning independence instrument of students are arranged based on a Likert scale. To determine the students' answer scores, the researcher set a scoring guideline for each statement. This guide is made so that it is uniform in giving scores to students' answers.

Research Procedure and Design

Phase I: Define

The define stage is the stage to define and define the learning requirements. This define stage includes five main steps, namely early-late analysis, learner analysis (learner analysis), task analysis (task analysis), concept analysis (concept analysis) and formulation of learning objectives (specifying instructional objectives).

Phase II: Design

At this stage, an initial draft (draft 1) is made to design an interactive student worksheet example (prototype) for the topic of sequence and series number patterns. At this stage, the LKPD, Research Instruments and questionnaires are designed. The initial design that will be produced is a learning implementation plan (RPP), student activity sheets (LKPD), research instruments in the form of tests, namely problem solving ability tests and questionnaires, namely student learning independence questionnaires.

There are three steps that must be taken at this stage, namely: (1) preparation of tests (criterion-test construction), (2) preparation of media (media construction) in accordance with the characteristics of the material and learning objectives, (3) selection of formats (format selection).), namely reviewing the formats of existing teaching materials and determining the format of teaching materials to be developed.

Phase III: Develop

The purpose of the development phase is to produce a revised draft of learning tools based on expert input and data obtained from field trials. On each validation sheet, the validator writes his assessment. The assessment consists of 5 categories, namely: invalid (score 1), less valid (score 2), moderately valid (score 3), valid (score 4), very valid (score 5). The validator also writes down his suggestions and comments. From the results of the expert's assessment for each device, it was analyzed by considering the validator's suggestions and comments. Furthermore, the results of the review were revised in accordance with the inputs given by the reviewers and resulted in Draft II.

Stage IV Deployment

The development of student worksheets reaches the final stage if it has received a positive assessment from experts and through development tests. The student worksheets are then packaged, distributed, and assigned to a wider scale. In this research, the dissemination stage is carried out by making it into a journal.

Result and Discussion

Validity of developed Interactive LKPD Toolkit

The validity test was carried out to see the shortcomings of the initial draft of the Interactive LKPD learning tool

which was designed by taking into account the problems in Class VIII MTs N 2 Labuhanbatu related to basic competencies, materials, sample questions, practice questions and evaluations at the end of each chapter. The team of experts (validators) involved in the development of this tool consists of five experts. the results of the validation of the five validators stated that they were valid with a total average LKPD of 4.4; RPP 4.4; The mathematics problem-solving ability test and student learning independence questionnaire are valid. Then the test results of the mathematical problem solving ability test instrument number 1, 2 and 3, respectively, show a validity test of 0.62; 0.81; and 0.80 then the test of mathematical problem solving ability can be used or valid. The same thing was also found in the instrument reliability test. The reliability of the mathematical problem solving ability test is 0.67 in the high category. The interactive LKPD learning tools developed have met the valid criteria.

The Practicality of the developed Interactive LKPD Tool

Based on the results of trial I and trial II, the interactive LKPD learning tools developed have met the very practical category in terms of the average assessment of teachers and students regarding the ease of use of the developed learning tools.

Based on the results of the calculation of the ease of use of learning tools, in the first trial the average score of the teacher and student assessment results p = 3.67 with practical criteria and in the second trial the average score of the teacher and student assessment results about the ease of use was obtained. on the use of learning tools is equal to p = 4.58 with very practical criteria. Thus it can be concluded that the interactive LKPD learning tool developed is very practical in terms of its ease of use.

The acquisition of practical learning tools is caused by several things. The things that support the practicality are: (1) the Learning Implementation Plan (RPP) which is prepared is easy to understand and easy to use by teachers and students in the learning process; (2) Student Worksheets that are compiled are easy to understand by students because the instructions given are clear, the writing is easy to read, and the pictures and tables used are easy to understand and interesting; and (3) Sentences of questions and statements on the mathematics problem-solving ability test and student learning independence questionnaire do not have more than one meaning and the instructions for processing are easy to understand.

This is supported by the research results of Ali, Roza and Maimunah (2020) which show that the development of learning tools to improve students' mathematical understanding skills using the 4D model (Define, Design, Develop, Dissemination) produces practical learning tools.

Effectiveness of the developed Interactive LKPD Toolkit

Based on the results of trial I and trial II, the development of the developed Interactive LKPD has met the very effective category in terms of: (1) Classical completeness of learning outcomes; (2) the activities of the students seen during the learning process; (3) student responses by filling out the response questionnaires given after the learning process ends.

The results of the first trial, the value of the effectiveness of the development of the interactive LKPD that was developed, got a value of 3.36 with a fairly effective category. Of course, based on these results, it needs to be reviewed based on the 3 determinants of the effectiveness of the development of this interactive LKPD. After the repair was carried out, the second trial was carried out with an effectiveness value of 4.67 with a very effective category. Based on these results, the improvements made from trial I to trial II have been successful.

In line with this, the research conducted by Jaya (2019) found that the results of the effectiveness test were reviewed based on the average score of effectiveness obtained, namely 4.61 with the calculation of the average effectiveness reviewed based on student activities, student responses and learning outcomes. learners.

Improving Students' Mathematical Problem Solving Ability

Analysis The increase in students' mathematical problem solving abilities in the first trial will be seen through the n-gain from the results of the pretest and posttest mathematical problem solving abilities in the first trial. The results of the summary of n-gain mathematical problem solving abilities can be seen in the table below:

Table 2. Summary of results of N-Gain math problem solving ability Test I

N-Gain	Interpretation	The number of students
$g \leq 0,3$	Low	5
$0,3 < g \leq 0,7$	Medium	11
$g > 0,7$	High	0

Based on the table above, it can be seen that there are only 0 students who get an N-Gain score in the range > 0.7 or experience an increase in their mathematical problem solving ability in the "High" category. For students who experienced an increase in their mathematical problem solving ability in the "medium" category or got an N-Gain score of 0.3 < g 0.7, there were 11 students and 5 other students scored N-Gain g 0.3 or experienced an increase. mathematical problem solving ability in the "low" category. So, the average gain in the first trial was 0.56 in the medium category.

Furthermore, the analysis of the increase in students' mathematical problem solving abilities in trial 2 will be seen through the n-gain from the results of the pretest and posttest of mathematical problem solving abilities in trial 2. The results of the summary of n-gain mathematical problem solving abilities can be seen in the table below:

Table 3. Summary of results of N-Gain math problem solving ability Test 2

N-Gain	Interpretation	The number of students
$g \leq 0,3$	Low	0
$0,3 < g \leq 0,7$	Medium	6
$g > 0,7$	High	10

Based on the table above, it can be seen that the students who got the N-Gain score in the range of 0.3 < g 0.7 or experienced an increase in their mathematical problem solving ability with the "medium" category were 6 students. For students who experienced an increase in their mathematical problem solving ability in the "low" category or scored N-Gain g 0.3, there were 0 students and 10 students who scored N-Gain g > 0.7 in the "high" category. So, the average n-gain in trial 2 is 0.73 with a high category so it can be concluded that there is an increase in students' mathematical problem solving abilities after applying learning using the Interactive LKPD.

Improving Students' Learning Independence

Based on the results of the calculation of the average score of students' learning independence in terms of positive attitudes and negative attitudes in Trial 1 for the positive attitude category with a value of 3.18 including the Rare criteria with an average score percentage of 63.75% in the Enough category and a negative attitude with a value of 3.02 is included in the Rare criteria with an average score percentage of 60.38% in the sufficient category while in trial 2 the average positive attitude result is 4.02 with the criteria Often with an average percentage of 80.52 % Good category and for the results the average negative attitude is 4.06 with the criteria of Sometimes with an average percentage of 81.15% in the Good category.

This is supported by research conducted by Melissa (2016) based on the results of a student learning independence questionnaire which showed an increase in the percentage of students' mathematics learning independence. In the initial condition, 20% of students reached the medium category, 71% of the students were in the high category and 9% of the students reached the very high category. In the first cycle, 73% of students reached the high category and 27% of the students in the very high category and in the second cycle, 59% of the students reached the high category and 41% of the students reached the very high category.

Based on the description above, it can be concluded that the development of Interactive LKPD has been able to increase the learning independence of students as expected. Thus the interactive LKPD that has been developed can be used by teachers to increase the learning independence of students at school.

Conclusion

The validity of the learning tools developed is included in the valid category with the average value of the total validity of the RPP, LKPD, mathematical problem solving ability test items and students' learning independence questionnaire items are also in the valid category.

The learning tools developed, namely the Interactive LKPD, met the practical criteria in terms of the results of the assessment by teachers and students regarding the ease of use of the developed learning tools in the practical category in the first trial and second trial.

The learning tool developed, namely the Interactive LKPD, has met the effective criteria. Effective criteria in terms of: (1) classical student learning completeness has been achieved in the second trial; (2) the activities of the students assessed by the observer during the learning process; and (3) positive student responses to the components of learning tools and learning activities developed.

The improvement of students' mathematical problem solving abilities using Interactive LKPD on the material of sequences and series numbers increased significantly from trial I to trial II.

Increasing the learning independence of students using the Interactive LKPD learning tool material on the pattern of numbers, sequences and series increased significantly in the second trial. In addition, the average of each indicator of student learning independence increased from trial I to trial II.

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